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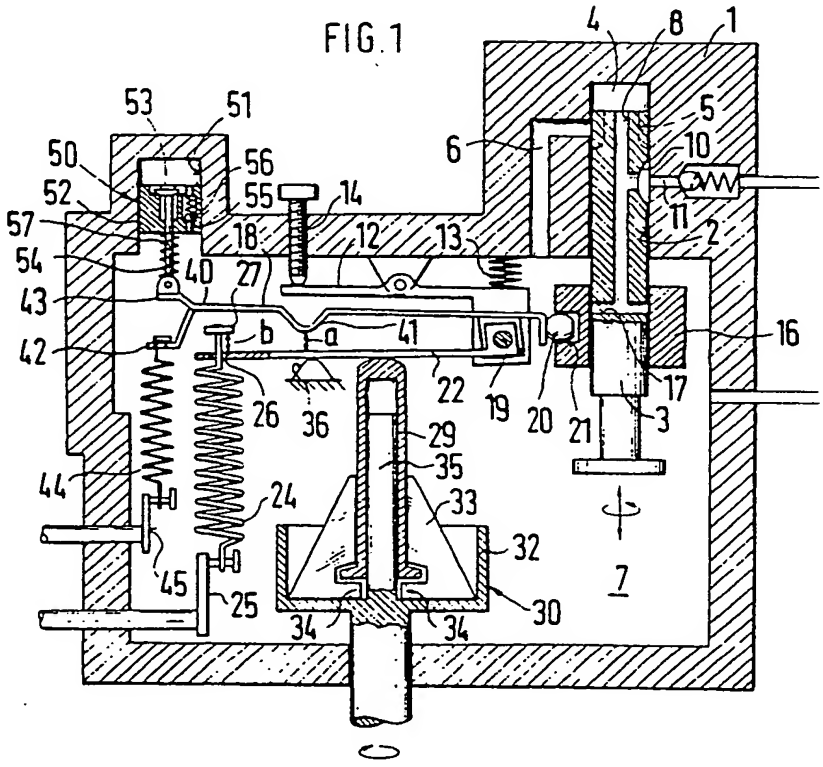
(54) A fuel injection pump for a motor vehicle internal combustion engine

(57) A fuel injection pump for a motor vehicle internal combustion engine has an adjusting device for a fuel quantity adjusting member (16), which device has a two-arm adjusting lever (18) and a governor lever (22) which is acted upon by a governor spring (24) and a centrifugal adjuster (30). In order to guard against rapid changes in load or speed, and hence to prevent the motor vehicle jolting, a hydraulic damping device (50) is connected to the adjusting lever (18) which may be adjusted by a small amount of force and which is acted upon by an idling spring (44), which is disposed so as to be fixed to the housing.

FIG.1



SPECIFICATION

A fuel injection pump for a motor vehicle internal combustion engine

The present invention relates to a fuel injection pump for a motor vehicle internal combustion engine.

Japanese Patent Specification No. 56-206 670, discloses a pump in which, in order to prevent sudden changes in rotational speed or load causing the motor vehicle to jerk, a damping device is associated with the adjusting device for the quantity-adjusting member. This damping device, which comprises a hydraulic damping cylinder, is connected to the adjusting device by way of a tensioning lever which is biassed by the force of the governor spring arrangement and against which the force of the centrifugal timer acts in the opposite direction by way of the adjusting lever when the internal combustion engine is in part-load or full-load operation. Since the difference between these two forces drops quadratically as a function of the rotational speed, and hence the response time of the damping device increases with increasing speed, jolting of the motor vehicle cannot be effectively prevented across the entire rotational speed range of the internal combustion engine.

Furthermore, an adjusting device for a quantity-adjusting member of a fuel injection pump is known from German Offenlegungsschrift No. 31 47 701, in which the governor spring arrangement and the centrifugal timer do not act on the adjusting lever, but on a lever which acts on said adjusting lever, so that said adjusting lever can be adjusted with a small amount of force.

It would be advantageous if a fuel injection pump could be provided which enables uniform damping to be obtained throughout the entire speed range.

According to the present invention there is provided a fuel injection pump for an internal combustion engine in a motor vehicle, including a fuel quantity-adjusting member which determines the quantity of fuel to be injected, and an adjusting device which adjusting device serves as a control criterion for the rotational speed of the internal combustion engine, which actuates the quantity-adjusting member and upon which act a governor spring arrangement, a speed-dependent centrifugal adjuster and a damping device, the adjusting device comprising an adjusting lever and a governor lever having a common fulcrum with and cooperating with said adjusting lever, wherein the governor spring arrangement and the centrifugal adjuster act on the governor lever and the damping device acts on the adjusting lever which is also acted on by said coaxially mounted lever and actuates the adjusting member.

The fuel injection pump in accordance with the present invention has the advantage that coupling the damping device to the adjusting lever, which is subjected to only a small, speed-independent adjusting force, enables uniform damping to be obtained throughout the entire speed range. Appropriate dimensioning of the damping device allows the response time to be set at the desired level. The behaviour of the fuel quantity adjusting device can be matched to the required magnitudes.

Preferably, one end of the idling spring arrangement acts on the adjusting lever, and the other end is suspended so as to be fixed to the housing. This is particularly advantageous as it produces a separation of the forces of the governor spring and the idling spring.

The invention is described further hereinafter, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 is a section through a simplified first embodiment of a fuel injeciton pump having an adjusting device in accordance with the present invention; and

Fig. 2 is a simplified side view of a second embodiment of an adjusting device in accordance with the present invention.

A pump piston 3 operates in a cylinder bore 2 in a housing 1 of a fuel injection pump and is moved in a reciprocating and simultaneous rotating manner by a drive (not shown). The pump working chamber 4 of this pump unit is provided with fuel from a suction chamber 7 in the housing 1 during the suction stroke of the pump piston 3 by way of longitudinal grooves 5 disposed in the outer surface of the pump piston and by way of a passage 6 in the housing 1. During the compression stroke of the pump piston 3, fuel is delivered from the pump working chamber 4 into a longitudinal passage 8 in the pump piston 3, from where it is fed by way of a distributor-type longitudinal groove 10 according to the angular position of the pump piston 3 into one of the delivery lines 11, which are disposed about the periphery of the cylinder bore 2 in correspondance with the number of cylinders to be supplied in the internal combustion engine.

An annular spool 16 is displaceably mounted on the pump piston 3 and opens a radial bore 17, which is connected to the longitudinal passage 8, during the compression stroke of the pump piston 3, thus producing direct connection between the working chamber 4 and the suction chamber 7, such that, from the instant of opening, none of the remainder of the fuel delivered by the pump piston 3 is fed to the delivery lines 11. In dependence on the position of the annular spool 16, the connection to the suction chamber 7 is opened at an earlier or later point during the compression stroke of the pump piston, and the delivery of fuel is interrupted The further the annular spool 16 is moved

be injected is also adjusted after a delay. As a result of the damping device 50, which acts in one direction only, given a sudden increase in the rotational speed effected by the centrifugal adjuster 30, the adjusting lever 18 is rapidly adjusted by the governor lever 22, since the head 53 of the rod 57, which is connected to the adjusting lever 18, can lift off the piston 52 against the force of the pressure spring 54, whereby the adjusting lever 18 moves the conrol spool 16 into a position for a somewhat lower quantity of fuel to be injected. In contrast, the damping device 50, which is controlled by the throttle bore 55, acts against rapid adjustment of the adjusting lever 18 and the control spool 16 in the event of rapid tensioning of the governor spring 24 or of a rapid reduction in rotational speed. As already mentioned above, a damping device which acts in two directions enables changes in the quantity of fuel to be injected to be delayed with respect to time in the event of either an increase or a decrease in the rotational speed. As a result of the fact that the damping device 50 is coupled to the adjusting lever 18, which is subjected to small forces only, for example the idling spring 44, which is attached so as to be fixed to the housing, the response time of the damping device 50 is substantially constant throughout the entire speed range.

The embodiment of the adjusting device in Fig. 2 is constructed and operates in substantially the same way as the one in Fig. 1. This embodiment differs from the embodiment in Fig. 1 in that the governor spring 24, in addition to its attachment to the governor lever 22, is also resiliently coupled to the adjusting lever 18. A pin 60 is hooked into one end of the governor spring 24 and penetrates through the bore 26 in the lever 22 and through a bore 61 in the adjusting lever 18, which is aligned with said bore 26, and its head 62 holds a weak intermediate spring 64 by way of a spring abutment plate 63, the spring 64 being located between said spring abutment plate 63 and the adjusting lever 18. The stop disc 27 for the lever 22 is also secured to the shaft of the pin 60. The intermediate spring 64 is intended to compensate for the play between the adjusting lever 18 and the lever 22.

CLAIMS

1. A fuel injection pump for an internal combustion engine in a motor vehicle, including a fuel quantity-adjusting member which determines the quantity of fuel to be injected, and an adjusting device which adjusting device serves as a control criterion for the rotational speed of the internal combustion engine, which actuates the quantity-adjusting member and upon which act a governor spring arrangement, a speed-dependent centrifugal adjuster and a damping device, the adjusting device comprising an adjusting lever and a governor lever having a common fulcrum with an cooperating with said adjusting lever, wherein the governor spring arrangement and the c ntrifugal adjuster act on the governor lever and the damping device acts on the adjusting leve which is also acted on by said coaxially mounted lever and actuates the adjusting member.

2. A fuel injection pump as claimed in claim 1, wherein said damping device comprises a hydraulic damping piston which is subjected t the internal pressure of the fuel injection pum and which has a throttle bore with an excess-pressure valve connected downstream thereof

3. A fuel injection pump as claimed in claim 1, wherein said damping device has a damping effect in both directions of adjustment.

4. A fuel injection pump as claimed in any of claims 1 to 3, wherein an idling spring arrangement also acts on the adjusting lever and at one end is fixed to the housing.

5. A fuel injection pump as claimed in claim 4, wherein said idling spring arrangement can be adjusted by an adjustable member.

6. A fuel injection pump as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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